Generative Adverserial Networks(GANs)

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Goal

Discriminative vs Generative models

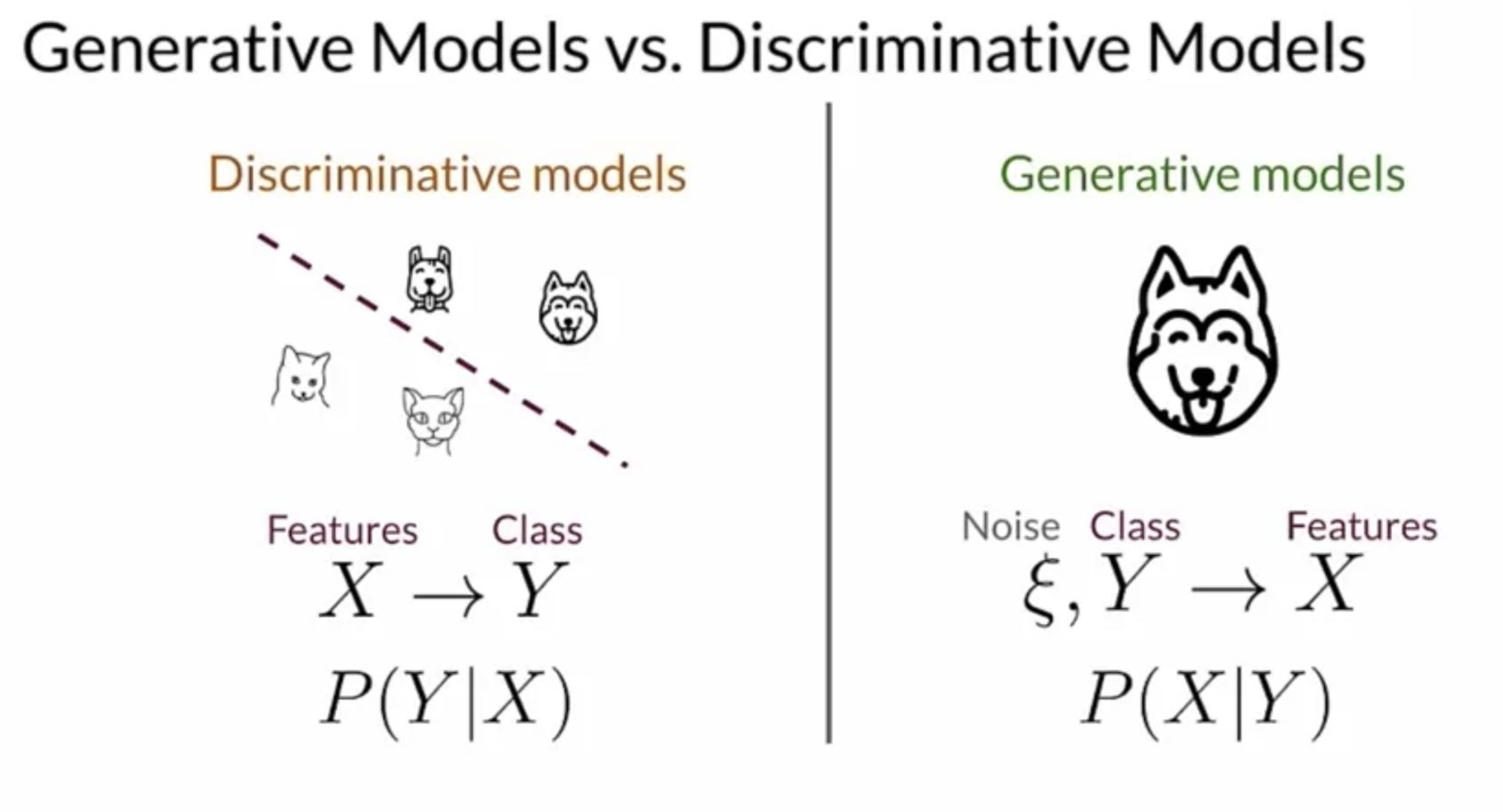


FIGURE – GANs network structure.

GANs network structure

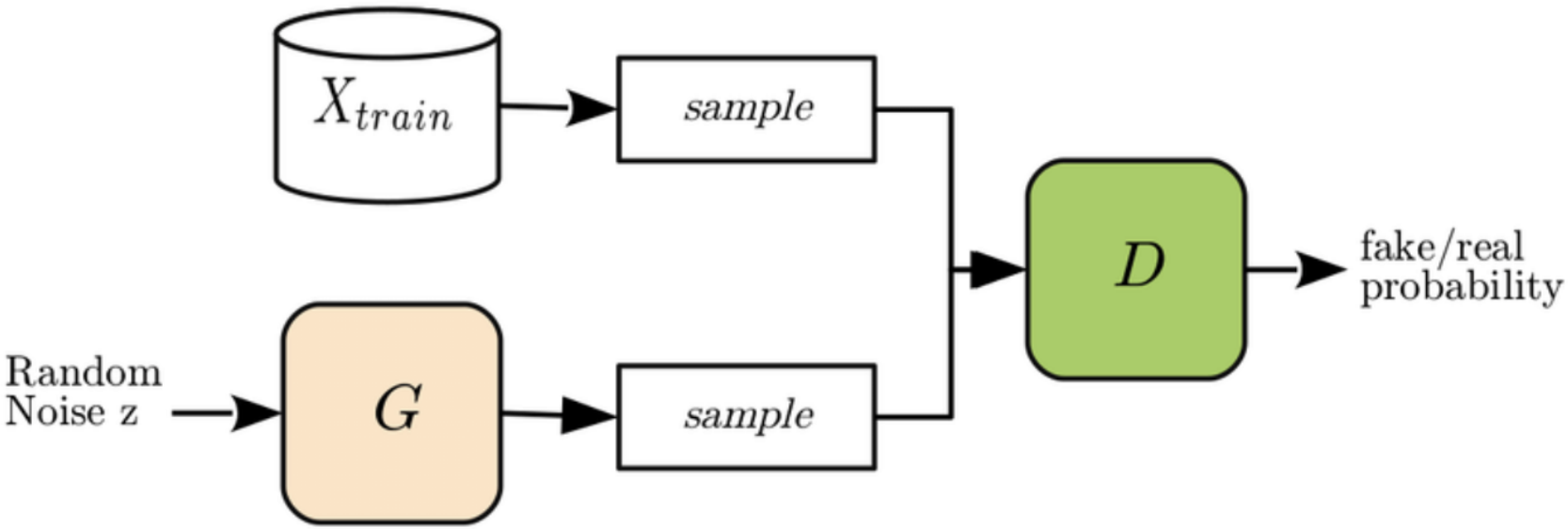
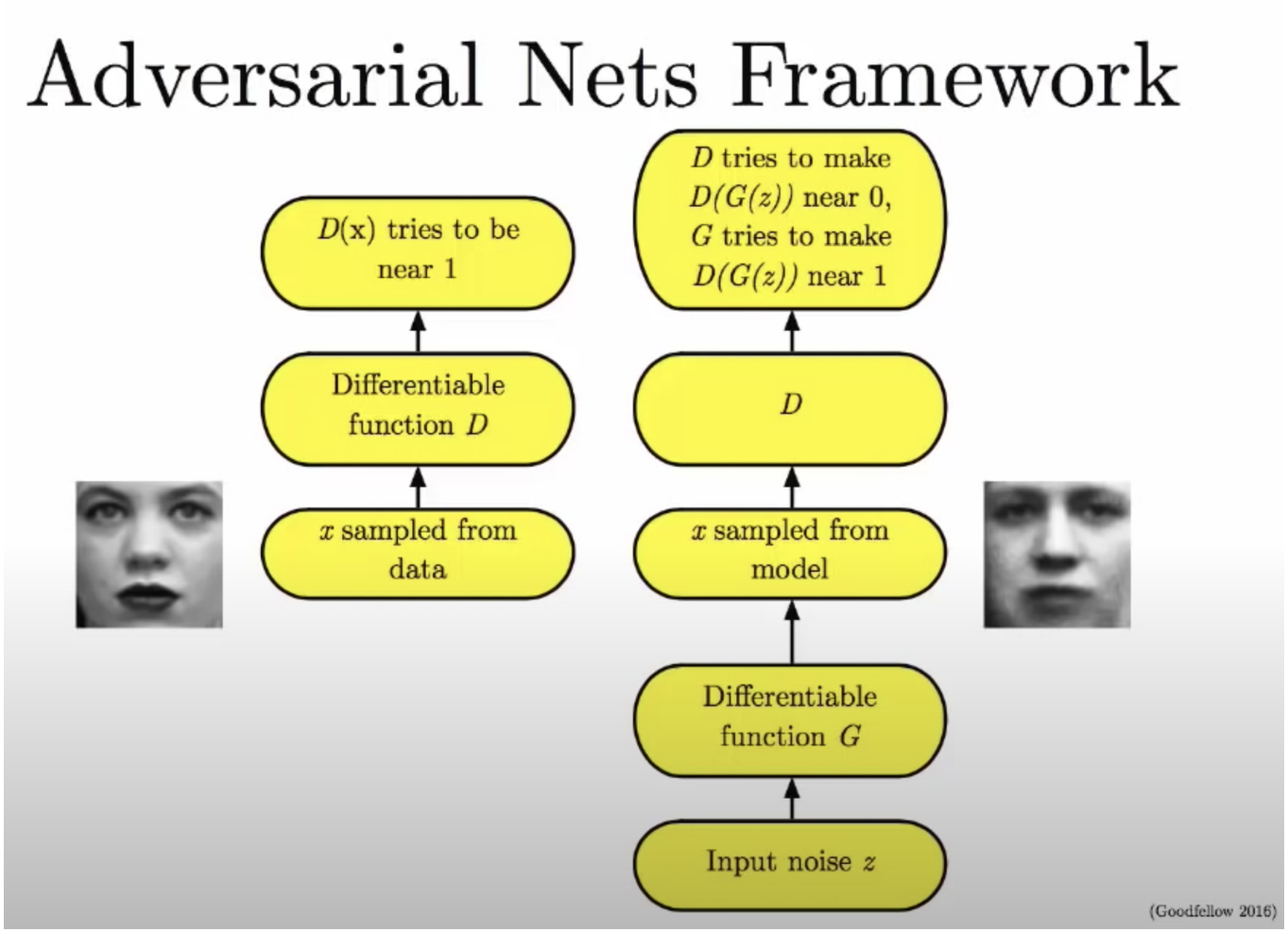


FIGURE – GANs network structure.

The Loss function

$$\min_G \max_D V(D,G) = \mathbb{E}_{\boldsymbol{x}\sim p_{\text{data}}(\boldsymbol{x})}[\log D(\boldsymbol{x})] + \mathbb{E}_{\boldsymbol{z}\sim p_{\boldsymbol{z}}(\boldsymbol{z})}[\log(1 - D(G(\boldsymbol{z})))]$$



Training loop

Algorithm 1 Minibatch stochastic gradient descent training of generative adversarial nets. The number of steps to apply to the discriminator, k, is a hyperparameter. We used $k = 1$, the least expensive option, in our experiments.

for number of training iterations **do**

for k steps **do**

- Sample minibatch of m noise samples $\{\boldsymbol{z}^{(1)}, \ldots, \boldsymbol{z}^{(m)}\}$ from noise prior $p_g(\boldsymbol{z})$.
- Sample minibatch of m examples $\{\boldsymbol{x}^{(1)}, \ldots, \boldsymbol{x}^{(m)}\}$ from data generating distribution $p_{\text{data}}(\boldsymbol{x})$.
- Update the discriminator by ascending its stochastic gradient:

$$\nabla_{\theta_d} \frac{1}{m} \sum_{i=1}^{m} \left[\log D\left(\boldsymbol{x}^{(i)}\right) + \log\left(1 - D\left(G\left(\boldsymbol{z}^{(i)}\right)\right)\right) \right].$$

end for

- Sample minibatch of m noise samples $\{\boldsymbol{z}^{(1)}, \ldots, \boldsymbol{z}^{(m)}\}$ from noise prior $p_g(\boldsymbol{z})$.
- Update the generator by descending its stochastic gradient:

$$\nabla_{\theta_g} \frac{1}{m} \sum_{i=1}^{m} \log\left(1 - D\left(G\left(\boldsymbol{z}^{(i)}\right)\right)\right).$$

end for

The gradient-based updates can use any standard gradient-based learning rule. We used momentum in our experiments.

FIGURE – Training loop.

Random noise

- sampled from normal distribution,
- mean 0 and std 1.

The Generator

- 4 non linear block sequences ,

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- each block : linear, Batchnorm, ReLu ,

The Generator

- 4 non linear block sequences ,
- each block : linear, Batchnorm, ReLu ,
- Linear + Sigmoid.

The Discriminator

- 3 non linear block sequences ,

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- each block : linear, LeakyReLu ,

The Discriminator

- 3 non linear block sequences ,
- each block : linear, LeakyReLu ,
- Linear.

Results

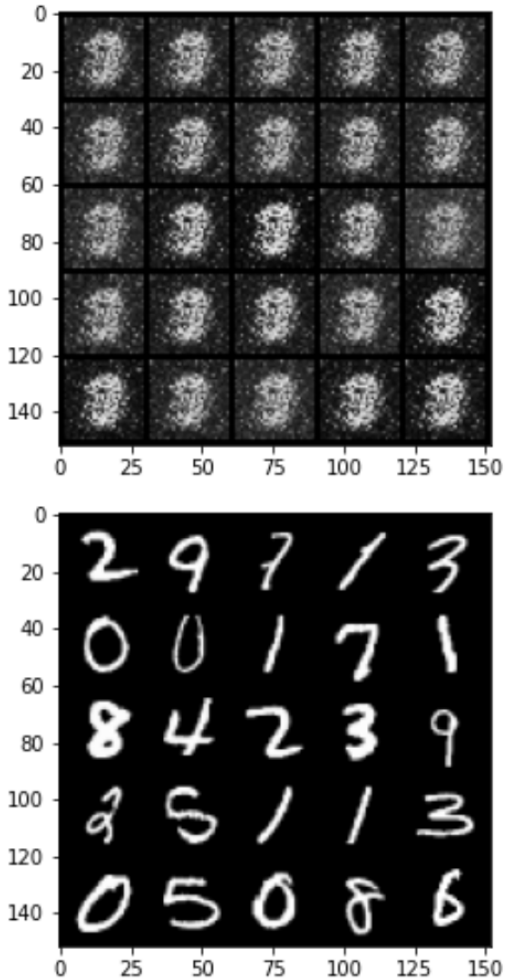

FIGURE – epoch 1.

Results

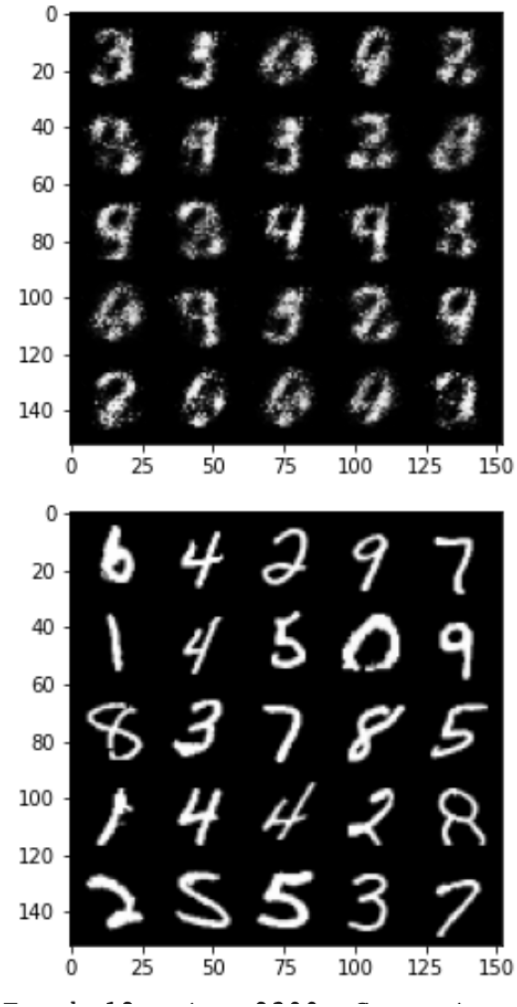

FIGURE – epoch 20.

Results

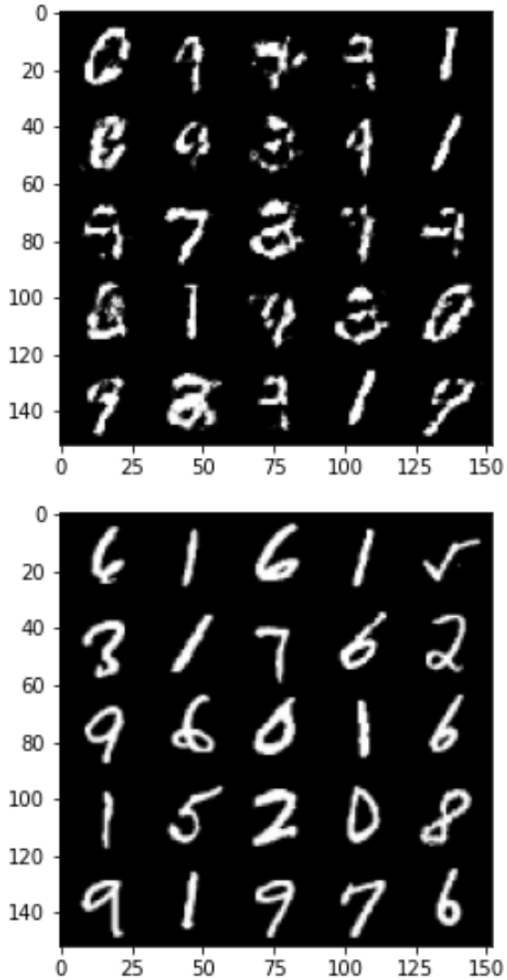

FIGURE – epoch 250.

Future work

- Convolutional layers insted of MLP ,

End

Thank you for your attention !